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RESEARCH NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
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WEED CONTROL AND FERTILIZATION IN WHITE PINE PLANTINGS OF WESTERN IOWA

Early survival of conifers planted in the loessal hill region of western Iowa has usually been poor. Most of the planting failures were probably due to insufficient moisture during the growing season. Moisture deficiencies result from drought coupled with high evapo-transpiration losses which are common in the prairie region. Highly calcareous soils and severe weed competition may limit moisture and nutrients available to seedlings during the first critical years after planting.

We tried to increase early seedling survival and growth by controlling weed competition with an herbicide and black plastic "mulch," by reducing soil alkalinity with an acidifying chemical, and by increasing soil fertility with fertilizers. We believed that the black plastic mulch (sheet) would also aid in conserving soil moisture. Mechanical methods for controlling weeds have been effective in Iowa, but they are usually more costly and less effective than chemical treatment and they must be repeated at frequent intervals.

We found that none of the treatments studied significantly affected survival or growth. The greater than average rainfall during the experiment probably minimized the competitive effects of weeds on pine seedlings.

The Study

We began the study in April 1961, to find better methods of establishing conifer plantations in western Iowa.[1/] Four weed-control treatments and four fertilizer-acidifer treatments were applied to determine their effect on the survival and growth of eastern white pine (*Pinus strobus* L.) seedlings. White pine was chosen because it is a widely planted species.

Seedlings were planted on north or northeast middle slopes in soils classified as Ida silt loam. Weeds were eliminated by disking or by plowing and disking before the seedlings were planted.

Two blocks were laid out on each of the three sites. Four rows of 40 graded white pine seedlings were hand planted in each block by the center-hole method. Trees were spaced 2 feet apart in the rows; rows were 4 feet apart. Each of the four rows received one of the following weed-control treatments:

One spraying with Simazine (4 pounds per acre)[2/]
Two sprayings with Simazine (2 pounds per acre each)[2/]
Covering with black plastic sheets ("Polyfilm")[3/]
Check (site preparation only)

1/ This study was established with the active cooperation of the Forestry Division of the Iowa State Conservation Commission, the Soil Conservation Service, two landowners in Woodbury County, and one landowner in Harrison County in western Iowa.

2/ Active Simazine ingredient. Sprays were made from the 80-percent wettable powder. Simazine was sprayed over the ground after planting. The second 2-pounds-per-acre treatment was applied in mid-June.

3/ Strips 0.004 inch thick, 4 feet wide, and 88 feet long were anchored in prepared furrows with soil. Tears were weeded and repaired early in 1962.

Each row also received six fertilizer-acidifier treatments:

10 trees--ferrous ammonium phosphate (7-35-0)[4]
- 5 trees received 4 ounces
- 5 trees received 2 ounces

10 trees--magnesium ammonium phosphate (8-40-0)[4]
- 5 trees received 4 ounces
- 5 trees received 2 ounces

10 trees--aluminum sulfate granules[5]

10 trees--no fertilizer

Average weed yields were measured in September 1961 by combining all clipped vegetation from four 1-foot-square plots in each weed-control row. The number and average height of weeds by species were tallied for each plot before clipping.

Periodically, soil samples were taken for pH determinations in the acid-treated and adjacent non-acid-treated rows. Twelve samples for each acid treatment were obtained from each block.

Results and Discussion

Seedlings

Weed-control treatments, fertilization, and soil acidification failed to increase white pine survival or growth significantly. After 2 years, survival averaged about 84 percent regardless of treatment. This is probably partly because the first and second growing seasons were wetter than usual, averaging 4 1/2 and 5 1/2 inches more rainfall than long-term means. These favorable moisture conditions tended to minimize competition between weeds and white pine seedlings. Species less light tolerant than white pine would probably respond more to elimination of weeds. Because the rows of trees were so close together the check trees probably benefited from the side effect of the weed-control treatments.

4/ The two phosphate fertilizers were placed in the planting holes.

5/ Granules (2,722 pounds per acre in 1961 and 5,445 pounds per acre more in 1962) were raked into the soil.

Differences in tree vigor were found, however. Fertilized trees had darker green foliage than unfertilized trees; trees in acid-treated plots had normal color; and trees in weed-control plots had longer needles and denser foliage than those in the check plots. Nearly all trees were free to grow in the weed-control plots, while the check trees grew among weeds.

Weeds

Weeds were controlled best by Simazine (table 1, fig. 1). One application of Simazine at 4 pounds per acre was as good as two applications at 2 pounds per acre; both gave full-season weed control of most annual broadleaf weeds and grasses (alfalfa, black bindweed, bromegrass, buffalo-bur, cocklebur, crabgrass, green foxtail, lambsquarters, pigweed, ragweed, redroot pigweed, sandbur, velvetleaf, wild lettuce, and yellow foxtail). Perennials, such as goldenrod, Maximilian's sunflower, milkweed, and thistles, were not controlled. Foxtail grasses were the most abundant invaders of check plots.

Table 1.--Effect of weed-control treatments on the number, height, and air-dried weight of weeds per square foot

Treatment	Average number of weed plants per square foot	Average height: Foxtail grass	Average height: All weeds	Average air-dried weight of weeds per square foot
	Number	Inches	Inches	Grams
Plastic mulch	1/ 1	12	13	16
Simazine 4 pounds per acre	4	6	7	10
Simazine 2 pounds per acre (twice)	4	8	10	13
Check	2/ 22	2/ 26	2/ 25	2/ 46

1/ Significantly fewer (F.05) weed plants than the Simazine-treated plots, but weeds in mulched plots offered more severe competition because they grew through the same slit as the seedling.

2/ Significantly more (F.01) weed competition than the other three treatments.

FIGURE 1.--This site was prepared by plowing and disking. After planting white pine seedlings, Simazine was applied as preemergent broadcast spray over the two rows of trees. Weeds were controlled effectively for 2 years. A row of check trees is hidden by weeds in the untreated plot at right.

Recommendations

Use Simazine to control weeds. For best results, prepare the site thoroughly by plowing and disking. Apply Simazine at the rate of 4 pounds per acre immediately after site preparation and before weeds emerge. Simazine can be applied safely before, simultaneously with, or after planting because it is absorbed through the roots.

On eroded Ida soils a lighter treatment (3 pounds per acre of Simazine) would probably prevent any foliage injury. Use 4 to 5 pounds per acre of active Simazine on heavy soils and soils high in organic matter, but on sandy soils (subject to leaching) only apply 2 to 2 1/2 pounds per acre of active Simazine.

On level to gently sloping land treat the entire area planted so as to eliminate food and cover for destructive rodents. On steep slopes subject to erosion, treat strips along the contour.

An incidental conclusion derived from this and related studies is:

Do not plant white pine on Ida soils. Even under favorable conditions, it grew only 2 to 3 inches in height annually. After 10 years, in another study in western Iowa, white pine failed completely on calcareous Ida soils, but eastern redcedar, ponderosa pine, Scotch pine, and Austrian pine survived and grew satisfactorily.

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